

IN THE CLAIMS:

Claim 1 (currently amended) An image transform method, for transforming original input image data into image data expanded by a ratio represented by a rational number or an integer, comprising the steps of:

reducing correlation in the vertical and horizontal directions of an image that is linearly expanded in the vertical and horizontal directions to generate first expanded image data by a rank order processing in a window having a predetermined size wherein a target pixel and its neighboring pixels in the linearly expanded image data are included;

performing linear interpolation, based on correlation with a target pixel constituting said original image data and neighboring pixels arranged in oblique directions, using said neighboring pixels to generate second expanded image data by determining an interpolation direction based on values of differences between said target pixel and said neighboring pixels; and

employing said first expanded image data and said second expanded image data in an arithmetic combination to generate a final image.

Claim 2 (cancelled) The image transform method according to claim 1, wherein said step of generating said first expanded image data includes the steps of:

raster-scanning a window having a predetermined size wherein a target pixel and its neighboring pixels in the linearly expanded image data are included;  
and

reducing vertical and horizontal directional correlation through a rank order processing in the window.

Claim 3 (cancelled) The image transform method according to claim 1, wherein said step of generating said second expanded image data includes the steps of:

determining an interpolation direction based on values of differences between said target pixel and said neighboring pixels; and  
performing linear interpolation in said interpolation direction.

Claim 4 (cancelled) The image transform method according to claim 1, further comprising the step of:

regarding, as an adjustment value, the personal preference of a user concerning image quality,

wherein, at said step of generating said final image, based on said adjustment value, said final image is generated by using said first and said second expanded image data.

Claim 5 (original) An image transform method, for transforming original input image data into image data expanded by a ratio represented by a rational number or an integer, comprising the steps of:

forming an image by linearly expanding original image data in the vertical and horizontal directions; and

reducing the vertical and horizontal directional correlation of said image through a rank order processing to generate a final expanded image.

Claim 6 (currently amended) An image transform method, for transforming original input image data into image data expanded by a ratio represented by a rational number or an integer, comprising the steps of:

forming an image by linearly expanding original image data in the vertical and horizontal directions; and

reducing the vertical and horizontal directional correlation of said image through a rank order processing to generate a final expanded image

~~The image transform method according to claim 5, further comprising the steps of:~~

determining, for said expanded image, whether the contrast in said original image data can be maintained at a predetermined level; and

extracting a high frequency component from said expanded image, when said contrast can not be maintained at said predetermined level, and adding said frequency component multiplied by a constant to said expanded image, or subtracting said frequency component multiplied by a constant from said expanded image.

Claim 7 (original) An image transform method, for transforming original input image data into image data expanded by a ratio represented by a rational number or an integer, comprising the steps of:

- reading a target pixel and neighboring pixels thereof in original image data;
- employing said target pixel and said neighboring pixels to calculate directional differences for the right oblique and the left oblique directions;
- employing said directional differences to determine a strong correlated direction; and
- performing linear interpolation for said target pixel using said neighboring pixels arranged in said strong correlated direction.

Claim 8 (original) The image transform method according to claim 7, further comprising the steps of:

- reading peripheral pixels arranged within a predetermined mask range adjacent to said target pixel and/or said neighboring pixels; and
- accumulating differences between said peripheral pixels, and between said target pixel and said neighboring pixels; and
- determining an interpolation direction, based on the cumulative value of said differences, and performing interpolation in said interpolation direction.

Claim 9 (original) An image transform method comprising:

- an input step of entering original image data to be expanded by a magnification of two or more;

a first process step of reducing the step-shapes or chain-shapes of oblique lines appearing when said original image data are expanded by doubled or greater in size;

a second process step of expanding, in the oblique direction, the structure of said original image data, and reducing a bulging shape appearing when a portion is expanded whereat vertical and horizontal lines of said original image data cross each other; and

an output step of outputting an image expanded by said magnification of two or more using said first and second process steps.

Claim 10 (original) An image processing apparatus comprising:

input means for entering original image data to be expanded;

vertical and horizontal directional interpolation means for interpolating said original image data in the vertical and horizontal directions;

vertical and horizontal directional correlation reduction means for reducing correlation of the obtained image in the vertical and horizontal directions;

oblique direction detection means for detecting an oblique direction having a strong correlation with a target pixel and neighboring pixels in said original image data; and

directional interpolation means for employing said neighboring pixels in said detected oblique direction to perform interpolation in said oblique direction.

Claim 11 (original) The image processing apparatus according to claim 10, further comprising:

generation means for generating expanded image data based on an image obtained by said vertical and horizontal directional correlation reduction means and an image obtained by said oblique directional interpolation means.

Claim 12 (original) The image processing apparatus according to claim 11, further comprising:

input means for entering, as an adjustment value, the personal preference of a user concerning image quality,

wherein said generation means employs said adjustment value to synthesize said image obtained by said vertical and horizontal directional correlation reduction means with said image obtained by said oblique directional interpolation means.

Claim 13 (original) The image processing apparatus according to claim 10, wherein said vertical and horizontal directional correlation reduction means performs the ranked median value selection, for the target pixel and its neighboring pixels in the linearly expanded image data, and thereby reduces the correlation of an image in the vertical and horizontal direction.

Claim 14 (original) The image processing apparatus according to claim 10, wherein said oblique direction detection means employs differences between said target pixel and said neighboring pixels to detect, with strong correlation, said oblique direction, and said oblique directional interpolation means performs linear interpolation in said oblique direction detected by said oblique direction detection means.

Claim 15 (original) An image processing apparatus for transforming original input image data into expanded image data comprising:

a vertical and horizontal directional linear interpolation unit for forming an image by linearly expanding original image data in the vertical and horizontal directions; and

a vertical and horizontal directional correlation reduction processing unit for reducing, for said image, a vertical and horizontal directional correlation using a rank order processing to generate a final expanded image.

Claim 16 (original) An image processing apparatus for transforming original input image data into expanded image data comprising:

an interpolation direction determination unit for reading a target pixel and neighboring pixels in original image data, for calculating directional differences between said target pixel and said neighboring pixels for right oblique and left oblique directions, and for determining an interpolation direction based on said directional differences; and

an oblique directional linear interpolation unit for performing linear interpolation for said target pixel by using said neighboring pixels arranged in said determined interpolation direction.

Claim 17 (original) The image processing apparatus according to claim 16, wherein said interpolation direction determination unit reads peripheral pixels arranged within a predetermined mask range adjacent to said target pixel and/or said neighbor pixels and adds together the differences between said peripheral pixels and said target pixel and said neighbor pixels, and determines said interpolation direction based on the cumulative value of said differences.

Claim 18 (original) An image display device, for transforming low-resolution original color image data into high-resolution expanded color image data, and for outputting said high-resolution expanded color image data, comprising:

first image expansion means for reducing the step-shapes or chain-shapes of oblique lines in said original color image data, and for outputting an expanded image wherein the vertical and horizontal structure is maintained;

second image expansion means for expanding the structure of said original color image data in the oblique direction, for reducing a bulging shape that appears at intersections of lines, and for outputting an expanded image; and

display means for employing said expanded images obtained by said first and said second image expansion means to display a final image.

Claim 19 (original) The image display device according to claim 18, wherein said original color image data includes thin lines obtained by anti-aliasing, and said second image expansion means performs interpolation based on pixels constituting the original thin lines, not based on pixels obtained by anti-aliasing.

Claim 20 (original) An article of manufacture comprising a computer usable medium having computer readable program code means embedded therein for causing image transformation, the computer readable program code means in said article of manufacture comprising computer readable program code means far causing a computer to effect the steps of claim 1.

Claim 21 (original) An article of manufacture comprising a computer usable medium having computer readable program code means embedded therein for causing image transformation, the computer readable program code means in said article of manufacture comprising computer readable program code means far causing a computer to effect the steps of claim 5.

Claim 22 (original) An article of manufacture comprising a computer usable medium having computer readable program code means embedded therein for causing image transformation, the computer readable program code means in said article of manufacture comprising computer readable program code means far causing a computer to effect the steps of claim 7.

Claim 23 (original) An article of manufacture comprising a computer usable medium having computer readable program code means embedded therein for causing image transformation, the computer readable program code means in said article of manufacture comprising computer readable program code means far causing a computer to effect the steps of claim 9.

Claim 24. (original) A program storage device readable by machine, tangibly embodying a program of instructions executable by the machine to perform method steps for image transformation, said method steps comprising the steps of claim 1.

Claim 25. (original) A program storage device readable by machine, tangibly embodying a program of instructions executable by the machine to perform method steps for image transformation, said method steps comprising the steps of claim 5.

Claim 26. (original) A program storage device readable by machine, tangibly embodying a program of instructions executable by the machine to perform method steps for image transformation, said method steps comprising the steps of claim 7.

Claim 27. (original) A program storage device readable by machine, tangibly embodying a program of instructions executable by the machine to perform method steps for image transformation, said method steps comprising the steps of claim 9.

Claim 28 (original) An computer program product comprising a computer usable medium having computer readable program code means embedded therein for causing image processing, the computer readable program code means in said computer program product comprising computer readable program code means far causing a computer to effect the steps of claim 10.

Claim 29 (original) An computer program product comprising a computer usable medium having computer readable program code means embedded therein for causing image processing, the computer readable program code



means in said computer program product comprising computer readable program code means far causing a computer to effect the steps of claim 15.

Claim 30 (original) An computer program product comprising a computer usable medium having computer readable program code means embedded therein for causing image processing, the computer readable program code means in said computer program product comprising computer readable program code means far causing a computer to effect the steps of claim 16.

Claim 31 (original) An computer program product comprising a computer usable medium having computer readable program code means embedded therein for causing image processing, the computer readable program code means in said computer program product comprising computer readable program code means far causing a computer to effect the steps of claim 18.